political leaders undergo a complete change. If the awakening does not come soon, the task of making up for the years of forced inaction will be almost impossible to accomplish.

From what has been said it will be seen that no definite hope can be given of an immediately beneficial result accruing from the deputation. It serves, however, to bring the matter somewhat prominently to the notice of the Government and of the general public, and if it accomplishes nothing more it will in this have paved the way for future reform. It is desirable that the public should be educated to know the advantages which electrical engineers are ready and anxious to confer upon them, and why it is that these have not yet been bestowed. Thirteen years ago Prof. Ayrton, in his oft-quoted Sheffield address, predicted that a time was coming when the Sheffield grinder would work amidst beautiful surroundings, deriving the power he needed from a small electrically driven motor. The time is now ripe for the realisation of that prophecy; in some few places, indeed, it is already begun, but for its free and rapid development there are many abuses and much restrictive legislation which must be removed. For electrical distribution the days of the small station supplying a limited area are numbered, and with them the days of effective municipal control. So also with electric traction; wide-spreading tramways connecting town with town and running far out into the country districts are needed to bring about decentralisation and to help to solve the pressing problem of overcrowding. We can hardly expect the municipalities to effect these changes; the arbitrary boundaries of the areas they control have no reference to the suitability of these areas as units for electrical distribution, and their interests are, moreover, to a certain degree directly opposed to decentralisation. Thus, quite apart from any considerations of the purity of the management or efficiency of municipal electrical undertakings, it will be seen that there is good reason in many cases for looking for better results to the nation from company working. In the train of developments such as would follow the removal of restrictive legislation, we may hope to find the improvement of our position as manufacturers of electrical machinery. The country lacks neither opportunities nor electrical engineers capable of making use of them. We may therefore reasonably look to the development of electrical undertakings to confer a double benefit upon the country; directly, by increasing the comfort and health of the people, and by facilitating commercial work of all kinds; and indirectly by increasing the number and size of electrical factories, and so contributing to the wealth and prosperity of the nation and helping it in the struggle with foreign competitors.

REPORT ON THE TEACHING OF GEOMETRY.

THE immediate result of Prof. Perry's Glasgow address has been the appointment of two committees, the work of which is now near to completion. The British Association committee has, we believe, concerned itself with the more general aspects of the problem. The committee of the Mathematical Association, largely composed of schoolmasters, is formulating a set of detailed recommendations, of which the geometry section was published in the May number of the *Mathematical Gazette* (George Bell and Sons).

The Mathematical Association committee contains delegates from the chief public schools within easy reach of London; it has, therefore, something of a representative character. Its recommendations are very definite; as the editor of the *Gazette* remarks, "it is very desirable that mathematical masters and others should fully avail themselves of this opportunity of placing on record their views as to the proposed changes." The secretary of the committee, Mr. A. W. Siddons, Harrow School, Middlesex, will be glad to receive criticisms of the report.

The study of formal geometry is to be preceded by a substantial introductory course, in which the subject-matter of geometry is to be treated experimentally and inductively. The pupil is to be carefully trained in the use of simple mathematical instruments; he is to be allowed to convince himself of the truth of geometrical theorems by numerical measurements and calculations. In this way he will make his first acquaintance with the main facts of geometry. When he has thus gained familiarity with the subject-matter, he will be in a position to apply the machinery of logic to his knowledge; he will be able to enter, with his eyes open, upon the task of consolidating into a consistent whole the facts he knows. Throughout his whole course he is to treat problems of construction in a practical way; he is not to be content with describing how the thing is done, he is to do it.

Passing to the formal study of geometry, Euclid, or rather a skeleton Euclid, is to be retained as a framework. Large omissions are recommended, but the logical order is to stand.

Theorems are cut loose from the limitations of construction by the admission of "hypothetical constructions." For example, the *pons asinorum* may be proved by bisecting the vertical angle, and thus dividing the isosceles triangle into two triangles that can be shown to be congruent by Prop. 4. For it is obvious that an angle has a bisector, even though the method of constructing it with ruler and compass may appear later in Euclid; the bisector might be found equally well by folding the triangle in two.

Constructions are to be taken out of the formal course and treated in whatever order seems advisable. It is clearly absurd to keep to Euclid's order of constructions unless we are confined to the use of his instruments, an ungraduated ruler and a pair of compasses that cannot be trusted to transfer a distance.

The following order is recommended in teaching the *theorems* of the first three books:—Book i., Book iii. to 32 inclusive, Book ii., Book iii. 35 to the end.

The course is to be lightened by the omission of a considerable number of dull and obvious propositions, such propositions being found more especially in Book iii. Definitions are not to be taught *en bloc* at the beginning of each book, but are to make their appearance only when needed.

It is suggested that two locus propositions should be added to Book i.—the locus of points equidistant from two points, and the locus of points equidistant from two lines. This will enable the pupil to inscribe and circumscribe circles to triangles at an early stage.

Playfair's axiom is preferred to Euclid's; and illustration by rotation is recommended in dealing with angles connected with parallel lines, triangles and polygons.

After Book i. we are to pass to Book iii., which by the omission of Props. 2, 4, 5, 6, 10, 11, 12, 13, 18, 19, 23, 24 is reduced to very modest dimensions. To cover the ground of the omitted propositions there is to be a preliminary discussion of the symmetry of the circle about a diameter, which can be managed experimentally by folding the circle and pricking holes round the semi-circumference.

The "limit" definition of the tangent is allowed; and Euclid's three propositions 16, 18, 19 are condensed into one—"The tangent at any point of a circle, and the radius to the point of contact are at right angles to one another."

Book ii. is to be illustrated by algebra; and in order to simplify the geometrical proofs a rectangle is to be defined as a parallelogram with one of its angles a right angle. The use of the signs + and − is sanctioned.

For Book iv. we find the proposal "that all propositions be omitted, as formal propositions, except 2, 3, 4, 5, 10, and that these be taken with earlier books, the rest of the book being treated as exercises in geometrical drawing."

Coming to Book vi., it is recommended "that an ordinary school course should not be required to include incommensurables; in other words, that in such a course all magnitudes of the same kind be treated as commensurable." This at once relieves teachers from an enormous task—that of explaining Euclid's definition of proportion. There is now nothing to be said beyond that the ratio of a to b is the fraction a/b. To meet this change, two alternative proofs are given for vi. 1, though attention is called to the continental practice of making the proof of vi. 2 self-supporting.

With regard to areas, the tendency of the report is to make the treatment algebraic. Euclid vi. 14, 15, 16, 17, 23 contain merely the one fact that the area of a parallelogram is $ab \sin\theta$; nothing is gained by concealing this fact from the student. It is definitely suggested that "numerical" trigonometry shall be taught concurrently with Book vi. "In connection with the formal course, as soon as the proposition that equiangular triangles are similar has been proved, the sine, cosine and tangent can be defined (if this has not been done earlier in the experimental course). In order to make the meanings and importance of these functions sink deeply into the pupil's mind, numerical examples should be given on right-angled triangles (heights and distances); these should be worked with the help of four-figure tables."

"In accordance with the spirit of the above proposals, the committee suggest that the following proposition be adopted:—If two triangles (or parallelograms) have one angle of the one equal to one angle of the other, their areas are proportional to the areas of the rectangles contained by the sides about the equal angles."

"All statements of ratio may be made in fractional form, and the sign = used instead of the :: sign. In the ordinary school course reciprocal proportion should be dropped, and compounding replaced by multiplying."

The report may be described as an attempt, on conservative lines, to simplify the study of geometry and to make it interesting. If the attempt is judged to be successful, now is the time to make examiners unstop their ears.

C. G.

SEISMIC FREQUENCY IN JAPAN.

IN no country has seismology been more carefully nurtured than in Japan. At the University we find a professor and assistant professor of this branch of science; in the Meteorological Department there is a bureau controlling more than 1000 observing stations, and, lastly, there is a committee composed of engineers, architects and men of science who, as an aid to carrying on investigations which will lead to a better understanding of earthquake phenomena, are supported by a Government grant.

This body, since its establishment eleven years ago, has already published thirty-six quarto volumes in Japanese and eight in English, and it is to the last of these, by Dr. F. Ōmori, professor of seismology, to which we now refer. Unlike many of the volumes by which it is preceded, which treat of construction to resist earthquake effects and kindred branches of applied seismology, this particular publication deals with questions which are purely scientific. Its title is "Annual and Diurnal Variations of Seismic Frequency in Japan," the investigation of other periodicities being left for a future occasion.

The materials analysed are 18,279 entries contained in earthquake registers from twenty-six meteorological stations which are distributed in a fairly uniform manner over the Japanese Empire. These registers, which for the most part are dependent on instrumental observation, are discussed separately, and it is in consequence of this method of treatment that conclusions new to seismology have been reached.

The first out of a series of seventy-six curves shows the monthly frequency of earthquakes in Tokio. In plotting this, as in plotting curves for other stations, those months where the ordinary seismic frequency has been affected by "after shocks" have been omitted; that is to say, the curves represent the normal frequencies in various districts. These omissions, all of which refer to the settlements which follow destructive earthquakes, are carefully epitomised. Dotted curves drawn through the mean position of monthly curves show annual and semi-annual periods. A comparison of the curves for seasonal seismic frequency shows that these may practically be divided into two groups. In one group the maximum frequency is in winter, whilst in the other group the maximum frequency is in summer. When we turn to the geographical distribution of the stations the records from which give these curves, it is found that they are distributed over two distinct areas—those which show a winter frequency lie in a district chiefly shaken by earthquakes having an inland origin, whilst those where the greater number of disturbances are noted in summer occupy an area shaken by earthquakes having a suboceanic origin.

In an endeavour to explain this striking result, the annual, monthly and diurnal frequencies are compared with corresponding fluctuations in barometric pressure. The general result arrived at is that the curves showing the winter frequency follow those of changes in barometric pressure, from which it may be inferred that an increase in barometric pressure has a marked effect upon the yielding of a land area. With the curves relating to earthquakes of suboceanic origin, it is seen that the annual variation is the reverse of the barometric pressure on land.

With regard to diurnal variation in seismic frequency, Dr. Ōmori concludes that this is probably due to corresponding variations in atmospheric pressure, but such frequency is not confined to earthquakes originating on the land. Single barometric fluctuations, even if they amount to 20 mm., are not generally related to any marked increase in seismic frequency.

Although the last two observations apparently contradict the more important result indicating a relationship between fluctuations in barometric pressure and the seasonal frequencies of earthquakes originating beneath the sea and on the land, arguments are adduced to show how such contradictions may be harmonised.

The distinction in the rules which governs the frequency of earthquakes with these distinctive origins, now brought forward for the first time, may probably be emphasised when, rather than analysing the registers from different stations—the entries in which may frequently be common to a number of such stations—an analysis is made of registers of earthquakes classified according to their origins. As illustrative of such materials we may refer to a catalogue of about 9000 shocks, published as vol. iv. of the *Seismological Journal of Japan*, in which each entry is referred to a district from which the shock it represents may have originated.

In conclusion, not only do we congratulate Dr. Ōmori on this new departure in seismology, but we also congratulate the Earthquake Investigation Committee on the admirable manner in which it has presented its results to those outside the pale of eastern ideography.

J. MILNE.